Problems and Progress in Studies of Diagenesis of Argillaceous Rocks
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The diagenesis of argillaceous rocks includes physical, chemical, and mineralogical changes occurring after the deposition of the sediment. Hedberg's observations, published in 1936, on the gravitational compaction of clays and shales serve well as a framework upon which to organize many of the subsequent researches on diagenesis of those rocks.

The preponderance of illite in marine mudstones (commonly shales) has been interpreted as a result of widespread diagenetic conversion of other clay minerals into illite. More extended researches indicate, however, that primarily formed, expanding montmorillonite is notably more resistant to conversion to illite than is the expanding clay originating as stripped or degraded illite. The conversion of clay minerals to illite or chlorite is probably a two-stage process: (1) cation exchange, controlled by energy relations, and (2) subsequent and more permanent cation fixation. Some glauconite is apparently formed diagenetically, although complete details of the process remain obscure. Clay minerals that are not readily susceptible to diagenetic change are indicators of provenance, whereas those modified by a change in surrounding conditions may indicate the environments of their deposition.

Diagenesis of non-marine mudstones may include fixation of potassium , and alternatively the depotassication of illite; kaolinization of other clays, desilication of clays to form hydrated aluminum oxides, and alternatively their silication; and conversion of montmorillonite to illite and glauconitic mica.

Diagenesis and Paragenesis in Limestones and Dolomites
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The apparent confusion among geologists about the meaning of "diagenesis" probably arises from the fact that there is no universally accepted definition of the word. There seems to be agreement that "diagenesis" begins with, or immediately after, deposition of a sediment, but considerable disagreement arises as to when "diagenesis" ceases.

In this paper, diagenesis refers to the chemical and or physical processes that change the textural and mineralogical characteristics of a sediment. On the basis of a study of some of these characteristics, discernible mostly in thin sections, it is possible to establish reliable sequences of mineral deposition. For this paper, such sequences observed in some limestones and dolomites are shown by paragenetic diagrams, and textural relations on which the paragenetic diagrams are based are shown in photomicrographs.

From an established sequence of mineral deposition in a rock it should be possible to determine an orderly progression of the diagenetic reactions that have taken place. A simple illustration would be a crinoidal limestone in which calcite forms not only distinct overgrowths on the crinoid fragments but also a cement between the enlarged fragments. Basically, the paragenesis would be (1) calcite: crinoid and other fossil fragments, (2) calcite: overgrowths, and (3) calcite: cement. If the deposition of the three calcites is definitely successive (that is, if the deposition of one calcite is completed before the other begins), some geologists might consider that lithification was complete after deposition of calcite (2) and that diagenesis ceased at that time. However, if there is any overlap in time of deposition of the three calcites, especially of (2) and (3), it seems logical to assume that diagenesis and lithification both terminated at the end of deposition of calcite (3).

Diagenesis of Reef Limestones
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The main original reef constituents are a skeletal carbonate framework, syngenetic carbonate detritus, and pore space.

Diagenesis alters these materials by various processes involving addition, removal, and reconstitution of materials.

Additive processes include the mechanical deposition of secondarily infiltered detritus; the precipitation of calcite in fibrous or bladed, turbid cavity linings; and precipitation of calcite in coarse, clear mosaics.

Subtractive processes involve removal of aragonite in solution and, during dolomitization, similar leaching of low-magnesium calcite.

Reconstitution includes (1) recrystallization or aragonite to calcite, and (2) reorganization of the unstable, high-magnesium calcite. This reorganization can go in two directions: to stable, low-magnesium calcite by the "purging" of excess magnesium (which is probably generally removed in solution); or to dolomite, by similar purging of excess calcium. In either process, attendant recrystallization leads to loss of microstructure and the obscuring of surface boundaries; if both framework and matrix are affected, they may blend into a homogeneous rock fabric which bears little resemblance to the original sediment.

The various diagenetic steps are illustrated by examples from the Permian Capitan reef, from the Triassic reefs of the Alps, and from the Cenozoic of Florida.

Cost of Finding Oil

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A plan is outlined for calculating the industry's cost of finding oil in an area. This is possible by an exhaustive examination of published data from which finding expenditures are calculated. Total dollar expenditures are related to barrels found. Barrels found are current reserve estimates of reservoirs discovered, corrected for future revisions and secondary recovery changes.

Comparisons of finding costs are made for three areas covering most of the interior United States. The areas are Kansas and Oklahoma, the Illinois-Michigan basin area, and the Rocky Mountains.

In the period 1942 through 1957, the cost of the average barrel found in the Rocky Mountains was $0.41. This is comparable with $0.57 and $0.70 per net barrel for Kansas-Oklahoma and the Illinois-Michigan basin areas.

Costs of finding oil are increasing in most areas of the United States at a faster rate than development and producing costs; they are expected to increase in the future. To find more oil at less cost is the challenge to the petroleum geologist.

Techniques of Prediction with Applications to Petroleum Industry

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The art of soothsaying, although probably not the world's oldest profession, can certainly offer strong claims for being its second oldest. Non-scientific soothsaying is based largely on astute guesswork and ambiguous statement, whereas scientific soothsaying, or prediction, consists in trying to foretell as accurately as possible the future evolution of a material system in terms of a knowledge of its mechanism, its past history, and of the physical data on which its evolution depends.

According to the second law of thermodynamics, the evolution of any material system, when viewed in its entirety, must be unidirectional and irreversible; hence, incapable of repetition. However, the evolution of some systems can be resolved into cyclical and non-cyclical components—the swinging pendulum versus the falling weight of a clock, for example. If the mechanism is understood, the prediction of a cyclical phenomenon for limited periods of time can often be made with great precision.

The production of oil and gas, although slightly affected by a minor superposed seasonal cycle, is predominantly an example of a non-cyclical phenomenon. The number of oil or gas pools still to be discovered continuously diminishes; the mean depth and cost of wells continuously increase; and the production of power from uranium (and probably later from deuterium also) is well advanced on its inexorable ascendancy.